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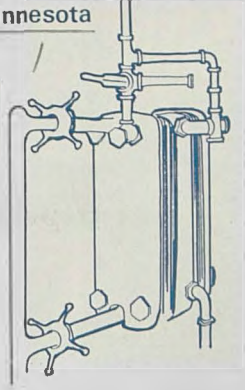

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USE OF THE MILKO-TESTER FOR ANALYSIS OF FAT IN CREAM

We've been taking a look at the feasibility of using the Mark III Milko-Tester for analyzing butterfat in cream. So far--we're still evaluating the data--prospects look pretty good.

There are two ways the Mark III can analyze fat in cream. If the range of fat percentage in the creams you wish to test is small, (varies by no more than 1 or 2 percent), you can calibrate the equipment on cream per se, and make readings direct. If, however, you wish to test fat levels over a wide range--let's say both on milk and cream--then you may wish to calibrate on whole milk and determine a regression formula for estimating fat percentage indirectly.

WHAT IS IMPORTANT?

The important considerations in making any analytical measurement are accuracy and precision. Accuracy is the ability of a test to agree with some predetermined reference standard, in this case either the Babcock or Mojonnier test results. Precision, on the other hand, is a measure of repeatability. It tells you what kind of agreement exists between two or more tests made on the same sample.

Both accuracy and precision are essential criteria for determining the usefulness of a test method. Beyond these two elements, speed is important. We can state simply that the Milko-Tester is a much more rapid method than either the Babcock or Mojonnier procedures. If it can match them in precision with an acceptable degree of accuracy, then it would be a worthwhile instrument to use.

HOW TO EVALUATE PRECISION

If you're from Missouri--or even Minnesota--you probably want to see for yourself. Let's assume that you do, and let's assume further that you would like to compare the precision--repeatability--of the Milko-Tester, and Babcock and/or other methods. First, it is important to realize that some variability will be due to individual differences--differences between technicians. But this should be a "known" difference. On the Babcock test for fat in milk, it is generally agreed that individual testers should not vary by more than $\pm$ 0.1%, even though some individuals would be well within that limit, others might be pushing that limit with every test.

Let's assume we're analyzing cream. One way of determining precision follows:

1. Over a period of time (not necessarily all at one time), analyze five different samples of cream, for example, cream from five different tanker truck loads.

2. Run five butterfat analyses on <u>each</u> sample.

3. Set up a chart:

Sample		1	2	3	4	5
Replicate No.	1	40.5	42.1	41.4	40.2	41.0
	2	41.0	41.9	41.1	39.7	41.5
	3	40.4	41.9	41.2	39.9	39.7
	4	40.0	42.3	41.4	40.5	39.8
	5	40.2	42.0	41.0	39.8	41.2
Average		40.42	42.04	41.22	40.02	40.64
Range		1.0	0.30	0.40	0.80	0.80

You really don't need the average values for purposes of this particular calculation. But proceed:

4. Determine the average range. (Range is the spread between the lowest and highest test results for each sample tested.) Above, the range for sample 1 was 1.0%, i.e., 41.0 - 40.0 = 1.0%. The average range is the sum of the ranges divided by 5, or 3.30 $\div$ 5 = 0.66.

5. Determine the standard deviation by dividing the average range by 2.326. (The value 2.326 is a statistical figure and only works when dealing with sets of 5 values.)

   Proceed: $0.66 \div 2.326 = 0.28$ (standard deviation)

The value thus derived is a measure of precision. It tells you that your technician is able to test within $\pm$ 0.28% a little over two-thirds of the time (68%). He can test within $\pm$ 0.56% (2 standard deviations) 95% of the time, and within $\pm$ 0.84% (3 standard deviations) 99% of the time. Assuming that he had been using the Babcock test, this would be the relative precision for that method specifically. You could then repeat the experiment using the Milko-Tester or Mojonnier or any other test and determine whether or not the standard deviation was better, or worse, or about the same. Remember: the standard deviation thus derived applies only to that range of fat test actually determined; in the above example, this range varied from 39.7 to 42.3. Above or below that range, precision might be expected to change--probably improving at lower levels of butterfat content, and worsening at higher levels.

You could repeat this experiment one or more times and average the standard deviations to get a more precise gauge of test precision, but one such experiment would give you some good working information.

We looked at the precision of the Babcock, Mojonnier, and Milko-Tester Mark III methods over a range of fat levels (see table 1).

Although there are some inconsistencies, due perhaps to the small number of samples, the precision tended to be less as the fat content went up. This would be expected. Moreover, Mojonnier precision was found to be only sightly better than the Babcock. The best precision--the least variability--was noted in the Milko-Tester method over the entire range of fat levels analyzed. From the figures shown, you can get a reasonable picture of the kind of test variability you must contend with when using one or more of these methods. In our work, on the average, the Milko-Tester proved to be about twice as precise as either the Babcock or Mojonnier procedures. Accuracy is another matter--perhaps we can cover that in another issue of Minnesota Dairy Products Processor.

Table 1. Precision of Babcock, Mojonnier, and Milko-Tester methods over a range of milkfat levels

Fat test range	Babcock		Mojonnier		Milko-Tester	
	No. of samples	Standard[1] deviation	No. of samples	Standard[1] deviation	No. of samples	Standard[1] deviation
5.0-10.0	11	0.15	11	0.098	10	0.073
10.1-15.0	4	0.17	4	0.186	6	0.096
15.1-20.0	7	0.15	8	0.323	6	0.085
20.1-25.0	8	0.21	8	0.181	12	0.139
25.1-30.0	16	0.21	15	0.157	14	0.141
30.1-35.0	12	0.345	13	0.232	15	0.149
35.1-40.0	8	0.26	8	0.274	10	0.163
40.1-45.0	8	0.27	8	0.238	7	0.144
45.1-50.0	8	0.355	10	0.252	5	0.095
AVERAGE		0.235		0.215		0.121

[1]Standard deviation is based upon triplicate Babcock and Mojonnier analyses, and quadruplicate Milko-Tester analyses. It was calculated for each set of replicate analyses and then averaged for the range of milkfat levels indicated.

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